EVOLUTION OF ACTIVE STRUCTURES IN NON-IDEAL DUSTY PLASMA

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We study self-propulsion of a metal-coated grains, suspended in gas, under laser irradiation. The motion is caused by photophoresis: i.e., absorption of a laser at the metal-coated surface of the particle creates radiometric force which in turn drives the particle. We observed experimentally the active Brownian motion (irregular or directed) caused by radiometric force at different Coulomb coupling of charged grains.

The charged dust represent a non-neutral or quasi-neutral systems (dusty plasmas) containing micron-sized particles (dust or grains) of a substance with electrical charges up to 10^2-10^5e. As a result of strong interaction of the strongly charged dust particles they may form the ordered structures of liquid and crystal types that are different from gas-like or chaotic systems.

Most of the laboratory studies of dusty plasmas are carried out in weakly ionized gas discharge plasmas. As a result, the laboratory dusty plasma is the unique object for studying the structure, phase transitions and transport properties of the systems of interacting grains on the “kinetic level”.

We study Brownian motion of a metal coated grains, suspended in rf gas discharge, under laser irradiation. The motion is caused by photophoresis: i.e., absorption of a laser at the metal-coated surface of the particle creates radiometric force which in turn drives the particle. The grains gain sufficiently high electrical charge (~10^2-10^5 of electron charge) under the flows of plasma particles or in the emission processes. The action of external forces and forces of interparticle interaction combined with dissipative mechanisms in these systems can lead to the self-organization of the system, resulting in formation of quasi-stationary crystal- or liquid-like structures. We observed experimentally the active Brownian motion (irregular or directed) caused by radiometric force at different Coulomb coupling of the charged grains.

We present the results of our studies the evolution of strongly coupled systems of charged dust particles at cryogenic temperatures (temperatures of liquid helium and nitrogen). The confinement of strongly charged (up to 10^7e) superconducting micron-sized particles in a static magnetic trap in liquid nitrogen or in nitrogen vapor at temperatures of 77–91 K is observed experimentally. The macroparticles with sizes up to 60 μm levitate in a nonuniform static magnetic field B ~ 2500 G. The formation of strongly correlated structures comprising as many as ~10^3 particles is reported.